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Insulation

THE CONTINENTAL
FIBRE COMPANY



1920



Main Office and Works, Continental Fibre Company

The Continental Fibre Company

Factory and Main Office
NEWARK, DELAWARE

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Offices and Agents Throughout the World





FOREWORD

THE various products manufactured by this company are standard in every respect, and as uniform in quality as the nature of the materials will permit.

Correspondence is cordially solicited on the subject of any proposed application of our products to New Uses, or to replace less satisfactory materials already in use. Any proposals we make are supported by trial lots without charge to responsible parties, and no obligation is incurred to purchase. Where our products cannot be used to advantage we will so advise our correspondents.

The Continental Fibre Company



VULCANIZED FIBRE





VULCANIZED FIBRE

VULCANIZED FIBRE is pure cotton cellulose chemically treated to form a hard bone-like material. It is known by various trade names such as Fibre, Hard Fibre, Horn Fibre, etc., but all are essentially the same and vary only in quality and uniformity with the skill and experience of the manufacturer.

We manufacture Vulcanized Fibre in the form of sheets, tubes and rods which may be cut, machined or bent to the shape required. It cannot be moulded.

VULCANIZED FIBRE SHEETS

Vulcanized Fibre sheets are made by passing cotton rag paper thru a strong acid or chloride bath and rolling it up on a large drum where each layer of paper sticks to the layer beneath it. When the proper thickness is obtained the acid

Vulcanized Fibre

soaked material is cut from the drum and cut in half forming two sheets of raw fibre. These sheets are put thru a soaking process in large wooden tubs, each subsequent tub containing a weaker solution, the last tub containing pure water.

The soaking process requires from one week to one year according to the thickness of the sheet, which makes it necessary for the fibre manufacturer to anticipate his needs and carry a large stock of finished sheets. It is this fact which makes the amount of fibre carried in stock a measure of the service which a manufacturer can render his customers. Under normal conditions our stock contains 1,000,000 pounds of finished fibre sheets and 2,000,000 feet of finished fibre tubing.

While the fibre sheets are soaking in pure water, several samples are tested for free acid. There is always a little acid left in the fibre, but it must be a very small amount. The sheets are then air dried. They shrink to one half the original thickness, 10% in length and 15% in width, making the fibre very tough and hard. The layers of paper cohere to such

Vulcanized Fibre

an extent that they cannot be distinguished except under a microscope.

Drying warps the sheets so that it is necessary to flatten them in a steam heated hydraulic press. The sheets are then put into stock for seasoning, for it has been found that if fibre is kept under proper atmospheric conditions, it gradually improves and at the end of several months' seasoning is greatly superior to new fibre. The following illustration shows one of our stock rooms for fibre sheets. It is constantly supplied with fresh air at 80° F in winter and kept well ventilated and dry in summer. The high quality of our product is in a large measure due to the care taken in seasoning.

Before shipping, the sheets are calendered to exact thickness. This process toughens the fibre somewhat and improves its surface.

The essential requirements of good fibre are pure paper, pure chemical bath of the proper strength, proper control of temperature and skillful handling thruout. The men in charge of our machines have made fibre for many years, and we are

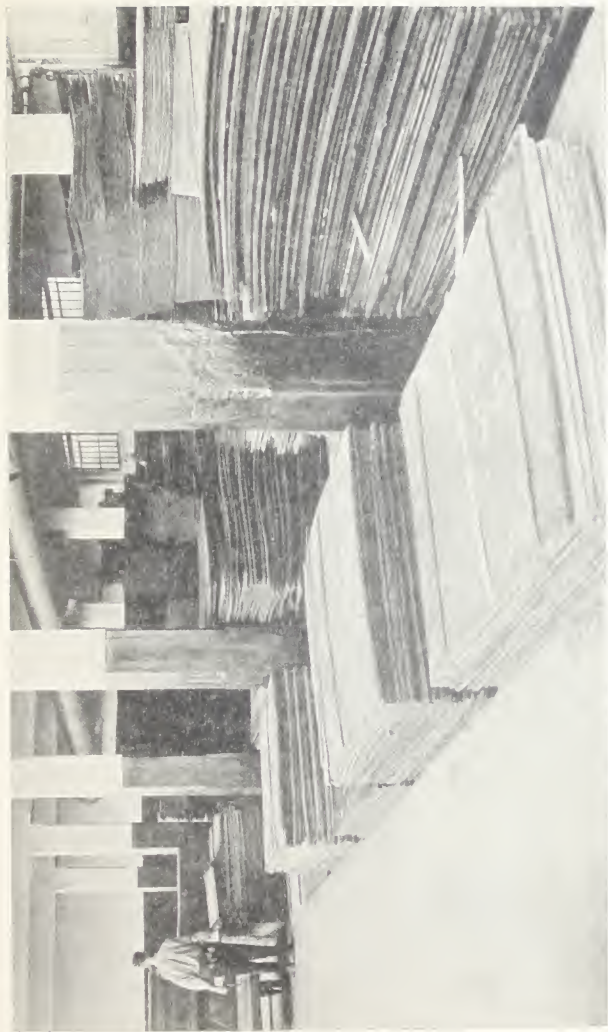
Vulcanized Fibre

very careful to use only the purest materials. We can state, therefore, that our fibre is second to none in quality. All comparative tests of various brands have shown it to be fully the equal and in many cases superior to others.

Physical Properties

If fibre is soaked in water it will swell, soften and lose most of its mechanical and electrical strength; it will, however, regain all of its original properties when re-dried, but it will be badly warped. Except in special cases where the swelling is an advantage fibre must be used in dry locations. It will not absorb oil or gasoline and is not affected by the ordinary solvents such as naphtha, alcohol, turpentine, acetone, etc.

Dry heat will not soften fibre and it will not melt under any conditions. As its temperature is increased it becomes brittle but retains its strength and insulating properties until it chars at 350° F (177° C).



One of our stock rooms for Vulcanized Fibre sheets



Vulcanized Fibre

Mechanical Properties

We have had many tests made to determine the strength of our fibre sheets in shipping condition, the average results of which are as follows:

	lb. per sq. in.
Tensile strength, cross direction	7,500
Tensile strength, machine direction	10,500
Compressive strength, parallel to laminations	9,000
Compressive strength, perpendicular to laminations	25,000
Transverse strength, maximum fibre stress	13,500

The tension tests were made on specimens having a reduced section 1 1-2" wide, 2" long and the same thickness as the sheet. The compression tests were made on square prisms 1-2"x1-2"x1" high and 1"x1"x2" high which are correct proportions for true compression tests. If specimens having an area of one or two square inches and a thickness of only 1-4" are tested, the results will be over 40,000 pounds per square inch. This is, however, more of a crushing test than a compression test. The transverse tests were made on beams 1-2" wide, 1" high and 5" long loaded in the centre, with supports 4"

Vulcanized Fibre

apart. The results show the stress in the outer fibre.

Electrical Properties

The electrical properties of fibre are variable depending on its moisture content which in turn depends on its location and the weather. However, if the fibre is kept dry it is a very good insulator as shown in the table below. Its toughness increases its value in this respect as most insulating materials will not stand hard use. Fibre may be pressed or driven into position.

The following table shows the dielectric strength of dry fibre sheets in shipping condition. Fibre should not, however, be subjected to more than 15 volts per mil (600 volts per mm.) for continuous service in dry places.

Thickness, inches	Volts per mil	Volts per mm.
1/32	330	13,000
1/16	300	11,800
1/8	260	10,200
1/4	180	7,100
1/2	100	3,900
1	60	2,400

Working

Fibre may be machined like metals, but this work requires special skill and a knowledge of the properties of the material which can be gained only by experience.

Punching—A plain punch and die may be used on fibre sheets up to 3-8" thick, but a smooth edge cannot be obtained on sheets over 1-8" thick. A plain die will cut about 100,000 pieces before regrinding is necessary. If the fibre is under 3-16" thick, it may be punched cold, but thicker material should be heated to about 130° F. The open follow-up or tandem type and the compound punch and die may be used with fibre strips up to 1-8" thick.

Shaving—A smoother edge is obtained on thin fibre if the blanks are cut large and finished in a shaving die. Shaving dies must be used on thicknesses from 3-8" to 1 3-4". A better job is obtained when working the fibre cold up to 7-16" thick, but when over 7-16" thick it must be heated to 130° F (54° C). A little oil or grease on the fibre or die is usually helpful.

Vulcanized Fibre

Turning—Fibre should be turned at a peripheral speed 30% faster than cast iron using a coarse feed and a wide nosed tool. The tool should have a large clearance but no rake. If possible, the piece should be turned to size in one cut, but in any case the finishing cut should remove from 1-8" to 3-16" as it is impossible to take a light cut and have a uniform diameter. The tool is dulled very quickly when turning fibre, so it should be sharpened often. No lubricant is needed.

Drilling—Fibre should be drilled dry using a fast feed. If the drill is ground properly the hole will be clean and true, but about .003" under size, hence, to prevent excessive heating the drill should be removed from the hole as soon as possible. To make a hole the exact drill size or a little larger, the drill should be ground with one lip a little longer than the other. A drill will last about three quarters of an hour before re-grinding is necessary.

Reaming—Do not ream fibre. Two or three holes will dull the reamer and the holes will not be to size.

Vulcanized Fibre

Threading—Ordinary taps and dies give very good results. A very little oil should be used. We have threaded 3,000 holes in 1-4" fibre with one 10-32 tap.

Milling—Use a high speed and coarse feed so that the cutter throws the chips away from the work. If possible, remove all the material in one cut.

Planing—Use high speed and coarse feed as in milling and take a deep cut which should never be less than 1-16".

Sawing—Band and smooth saws made specially for cutting fibre may be obtained from most saw manufacturers. A smooth saw will last half an hour on 1-8" fibre, twenty minutes on 1-2" and fifteen minutes on 1" before being re-sharpened. A band saw will last from one to one and a half hours on 1-8" fibre and one-half hour on 3-4". Band saws should be re-set every day. We find it necessary to have an automatic saw filing machine for each saw bench in order to keep the saws sharp at all times.

It will be noted from the foregoing that fibre is very hard on cutting tools and

Vulcanized Fibre

dulls them very quickly. However, with sharp tools and the proper speed and feed, good results can be obtained in any machining operation. When machining fibre, the operator should always remember that the amount of moisture in the fibre changes with the weather and a piece which is machined to exact dimensions one day may be larger or smaller the next. Fibre is a tough material, however, and may be forced into position if not exactly the right size.

Sheet fibre may be bent if it is first immersed for five or ten minutes in a steam bath at atmospheric pressure. The steam softens the fibre, but when cool and dry, it will reharden and retain the desired shape.

Fibre may be knurled, embossed and stamped in the same manner as other materials.

We give the foregoing information for the benefit of those who wish to do their own machining. We are prepared, however, to furnish to specification articles made of Vulcanized Fibre involving any of the aforementioned machining operations.

Vulcanized Fibre

Sizes

Standard sheets are approximately 4 feet wide and 6 feet long and can be supplied in any thickness from .005" to 2". Sheets 4 feet wide and 12 feet long can be furnished on special order. When ordering pieces cut to size or machined, dimensions may be given in decimal or fractional parts of an inch or in metric units.

Colors

Sheets of Vulcanized Fibre for ordinary purposes are made in three colors: red, black and a natural color (approaching white). Our trunk fibre, however, is made and kept in stock in red, black, white, granite, russet, olive, brown and walnut. The quality is identical in all colors.

Uses

Sheet fibre is well adapted for insulating the slots and wire ways in all kinds of electrical machinery. We carry a large stock of .010" and .015" which are the thicknesses generally used for this work and can make quick shipments. Thicker

Vulcanized Fibre

sheets are used for switch bases, supports, insulating shims, etc., or in any place where a strong insulating material is required. It is well adapted for use in switches, receptacles, plugs, etc., where reliable insulation must be provided in the least possible space.

Gears made of Vulcanized Fibre are noiseless and have a long life. Light gears may be made entirely of fibre, but gears for heavy duty require brass or iron end plates. We do not recommend large fibre gears made from one thickness as the unequal expansion will throw the pitch line out of a true circle and cause rapid wear of the gear. They should be built up of several thicknesses bolted together, for fine work we recommend our Grade G, Bakelite-Dilecto.

Rollers and Casters of Vulcanized Fibre may be used for furniture, cash carriers, looms, roller-skates, rolling-doors, etc. They will be found to deaden noise and wear well.

Pulleys—Vulcanized Fibre is an excellent material for grooved pulleys. It is

Vulcanized Fibre

easily turned in a lathe and has sufficient strength for a key without reinforcement.

Pulleys for flat belts may be made by bolting or riveting together a number of fibre discs. With a stock of sheet fiber on hand such pulleys may be quickly made up for use when the pulley required is an odd size or cannot be obtained. We have several fibre pulleys in our mill up to 12" diameter and 6" face and have found that they wear better than wood and paper pulleys. The coefficient of friction is the same as a paper pulley.

If a steel pulley is too narrow for its load a disc of 1" fibre bolted to each side will give two inches more face and greater holding power.

Journals—Light and high-speed shafts running in Vulcanized Fibre journals will run cool with very little lubricant, the journals themselves suffering little or no wear.

Railroad Insulation—We are prepared to furnish Vulcanized Fibre Insulation guaranteed to meet the standard specifications, to fit any insulated joint. Our railroad fibre is fully equal in all respects to

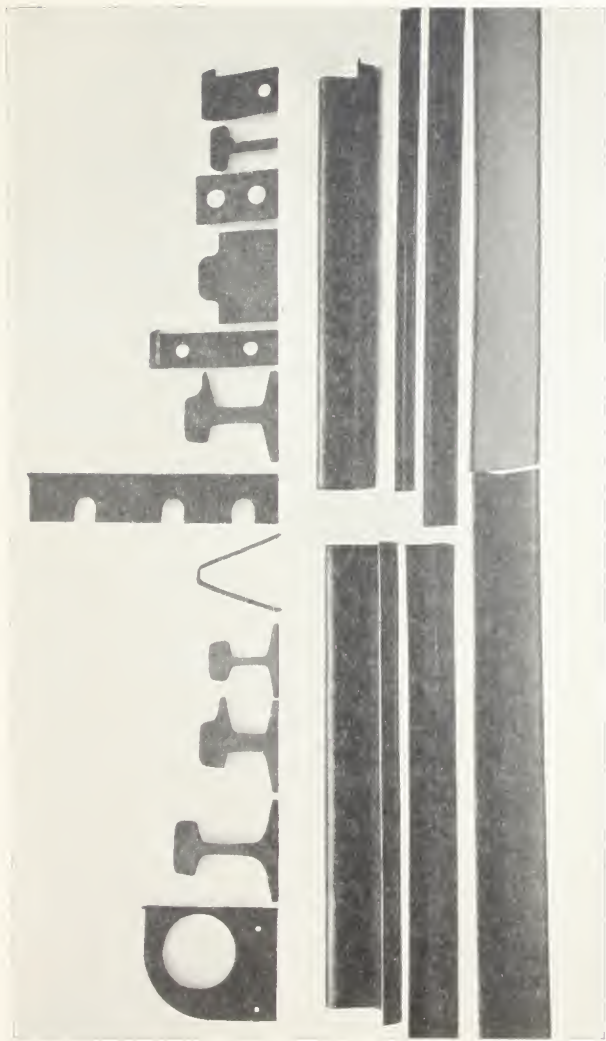
Vulcanized Fibre

that offered by others, and has lasting qualities excelled by none. It is made especially to withstand the rough service of track work. For the highest quality of track insulation our Continental-Bakelite is offered.

Trunks—Having made a thorough investigation of the special requirements of trunk and case manufacturers we can say frankly that while we may not be able to furnish the cheapest fibre for this purpose, there is no doubt that we can furnish the best—both in quality and color. We have sacrificed cost to quality in the formula we have adopted, as we believe that makers of these articles prefer a uniform color and quality above all else.

Roving Cans and Receptacles—Our Vulcanized Fibre meets all requirements for the manufacture of roving cans, waste paper baskets, etc. It may be obtained in standard sheets approximately 48"x72" or cut to size in any thickness or color. We do not manufacture these articles.

Tags and Novelties—Key tags and advertising novelties made of our Vulcanized Fibre have a neat appearance, are strong



Railroad Track Insulation made of Vulcanized Fibre and Continental-Bakelite



Vulcanized Fibre

and lasting. They may be printed or stamped.

Automobiles—There are parts of automobiles and airplanes to which Vulcanized Fibre is especially suited and its use in this respect is constantly increasing. Timer rings, small gears, pulleys, buttons, handles, wire ways, instrument boards, shims, wedges, washers, lunch and tool boxes, etc. are made of Vulcanized Fibre.

Approximate Weight of Standard Vulcanized Fibre Sheets

Thickness inches	Weight pounds	Thickness inches	Weight pounds
1/64	2½	5/8	100
1/32	5	11/16	110
3/64	7½	3/4	120
1/16	10	13/16	130
3/32	15	7/8	140
1/8	20	15/16	150
5/32	25	1	160
3/16	30	1 1/8	180
7/32	35	1 1/4	200
1/4	40	1 3/8	220
5/16	50	1 1/2	240
3/8	60	1 5/8	260
7/16	70	1 3/4	280
1/2	80	1 7/8	300
9/16	90	2	320

To obtain the approximate weight of any Vulcanized Fibre piece allow one pound for each twenty cubic inches.

Vulcanized Fibre

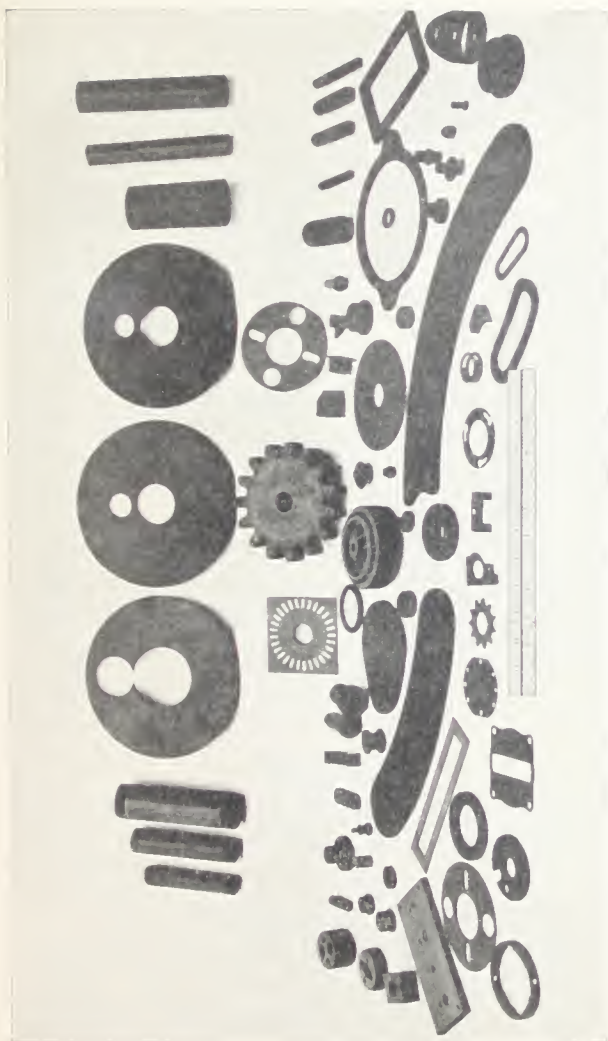
VULCANIZED FIBRE TUBES

Vulcanized Fibre tubes are made by the same process as sheets except that after passing thru the chemical bath the paper is rolled up on mandrels. When the required thickness is obtained the mandrels are pulled out and the tubes put thru the same soaking process as the sheets. When pure they are slipped on drying mandrels which have a diameter equal to the inside diameter of the finished tubes. Drying shrinks the tubes tightly to the mandrels making the inside diameter exactly right. The tubes are then rolled to the exact outside diameter acquiring a good polish at the same time.

We use the same care to make every tube of the highest quality as we do in making the large sheets. Fibre tubes have, therefore, the same physical properties as fibre sheets.

Mechanical Properties

We have had many tests made to determine the strength of our fibre tubes in shipping condition the average results of which are as follows:



Pieces machined from Vulcanized Fibre sheets, tubes and rods



Vulcanized Fibre

	lbs. per sq. in.
Tensile strength	25,000
Compression strength	50,000-60,000

The compression tests were made on pieces of tubing of 1" outside diameter and 2" high with various wall thicknesses. The heavier walled tubes have the higher compressive strength.

Electrical Properties

Tests made under oil with 60 cycle alternating voltage show a dielectric strength for Vulcanized Fibre tubes of various wall thicknesses of 250 volts per mil (10,000 volts per mm.). For continuous service in dry places fibre tubes should not be subjected to more than 15 volts per mil (600 volts per mm.).

Working

The data given above for working fibre sheets is equally applicable to the working of fibre tubes.

We are prepared to furnish to specifications any parts which can be machined from fibre tubes. On large orders for turned parts between 3-16" and 1-1/4"

Vulcanized Fibre

outside diameter, we can do this work on automatic lathes.

Sizes

Vulcanized Fibre tubes are made from two to three feet long with inside diameters from 1-8" to 3" and any wall thickness up to 1-2". They can be made especially to order with almost any inside diameter.

Colors

The colors carried in stock are red, black and natural (approaching white).

Uses

Condenser ferrules made of short lengths of Vulcanized Fibre tubing make the most satisfactory packing for surface condensers. They are dry when driven in and expand when wet, making a perfectly tight joint.

Vulcanized Fibre in tube form is the standard material for fuse cases both re-fillable and non-refillable. The clean sharp threads which may be cut on our tubes,

Vulcanized Fibre

their good machining qualities and the ability to stand repeated "blows" make them satisfactory for refillable fuse cases.

Whenever a bolt or rod is to be insulated for low voltage, slipping a fibre tube over the bolt with fibre washers under the head and nut will be found to be the cheapest and best method. This method has been used for insulated rail joints, generator bearing pedestals, magnet cores, etc., and has always proven satisfactory. (For high voltage insulating tubes we recommend our Bakelite-Dilecto and Continental-Bakelite).

Short lengths of Vulcanized Fibre tubing make excellent terminals for flexible wires and instrument cords. They are neat in appearance, cheap, easy to make and provide a strong insulating cover for the joint between wire and tip. Larger tubes make good handles for plugs on test boards.

VULCANIZED FIBRE RODS

Vulcanized Fibre rods are turned from sheets in special rod machines and therefore have the same physical and mechan-

Vulcanized Fibre

ical properties as sheet fibre. Our rods have a smooth surface and uniform diameter. They are fairly straight when made but like sheets will warp if allowed to absorb moisture.

Working

The data given above for working sheet fibre is equally applicable to the working of fibre rods. They can be threaded with the same dies used for threading metal rods.

We are prepared to furnish any parts which can be turned from rods and if the size of the order permits we can do this work on automatic lathes with rods of any diameter from 3-16" to 1 1-4".

Sizes

Rods are furnished in any length up to 66" and from 3-32" to 2" in diameter.

Colors

The colors are red, black or natural, the quality being identical in all colors.

Vulcanized Fibre

Uses

A great variety of small parts for machines and apparatus can be made from Vulcanized Fibre rods such as handles, levers, switch hooks, buttons, knobs, bushings, posts, shafts, etc. They are much cheaper than hard rubber and better than wood.

Vulcanized Fibre

Vulcanized Fibre Sheets, Tubes or Rods are used for

Advertising Novelties	Packing
Brake Bands	Packing Cases
Brake Shoes	Plugs
Bushings	Posts
Buttons	Press Plates
	Pulleys
Castors	
Chair Seats	Receptacles
Condenser Ferrules	Rollers
Cord Terminals	Roving Cans
Cutting-Blocks	
Discs	Sample Cases
Door Stops	Shafts
Dust Guards	Shims
	Spool Heads
Fuse Cases	Spoons
	Switch Bases
Gaskets	Switch Hooks
Gears	
Gibs	Tags
Glazing Straps	Thrust Collars
	Thrust Washers
Handles	Timer Rings
	Tool Boxes
Instrument Panels	Transmission Hands
Insulation	Trunk Angles
Journals	Trunk Bands
Knobs	Washers
	Waste Baskets
Levers	Wedges
Liners	Wheels
Lunch Boxes	Wire Ways
Markers	Valve Discs

CONITE





CONITE

CONITE is a specially prepared thin fibre having greater tensile strength, toughness and dielectric strength than the regular grades of Vulcanized Fibre. It contains no free acid.

The toughness of Conite is demonstrated by tests as follows. First, a piece in shipping condition was bent twice around a mandrel having a diameter only ten times the thickness of the piece. Second, similarly after baking at 180° F (82° C) for six hours. Third, the same piece was baked at 250° F (121° C) for twelve hours and bent twice around a mandrel having a diameter fifty times the thickness of the piece. Fourth, similarly, after baking at 250° F for twenty-four hours. Fifth, similarly, after baking at 250° F for forty-eight hours. In none of these tests did Conite show any sign of fracture.

Conite

Its moisture absorption, insolubility and other physical and chemical properties are the same as for regular grades of Vulcanized Fibre.

The tensile strength of Conite is 16,000 pounds per square inch with the grain and 8,000 pounds per square inch across the grain.

Conite absorbs moisture easily and as the amount of moisture in a material greatly affects its dielectric strength this property will be variable. In ordinary shipping condition however Conite has a dielectric strength of 400 volts per mil for .005" thickness, with proportional values for other thicknesses. A safe electrical stress for continuous use in dry places is 20 volts per mil (800 volts per mm.) of thickness.

Conite may be sheared, sawed, punched, bent, stamped and embossed without splitting or cracking.

Due to the special process of manufacture the production of Conite is limited to sheets from .005" to .020" in thickness, measuring approximately 3 ft. wide and 6 ft. long. Continuous rolls 36" wide

Conite

weighing 100 to 150 pounds may be obtained in any thickness up to .020".

Conite is uncolored and varies from dark grey to light grey or yellow white.

Conite can be used as a higher quality material for any purpose to which Vulcanized Fibre would be applicable. Its greatest tensile strength, toughness and dielectric strength, however, make it especially suitable and more economical for insulation of electrical apparatus.

Approximate Weight of Standard Conite Sheets

Thickness inches	Weight pounds
.005	.65
.010	1.30
.015	1.95
.020	2.60
1/32	4.1
3/64	6.1
1/16	8.1
5/64	10.1
3/32	12.2
7/64	14.2
1/8	16.2

To obtain the approximate weight of any Conite piece allow one pound for each twenty cubic inches.



BAKELITE-DILECTO





BAKELITE-DILECTO

BAKELITE-DILECTO is a hard, strong, insulating material made by hot pressing paper which has been saturated with raw Bakelite. By this process we have produced a material which has all the well known properties of Bakelite and at the same time possesses great mechanical and dielectric strength.

Our Bakelite products and methods of manufacture are fully protected by patents, granted or pending, which are owned by us or by others to whom we are licensed.

Bakelite-Dilecto is manufactured in the form of sheets, tubes and rods. The sheets are not necessarily made flat nor the tubes and rods of circular section, for any cylindrical shape with uniform wall thickness may be made in special moulds. When once made, however, its form cannot be altered except by machining.

Bakelite-Dilecto

As we are the original manufacturers of laminated phenol formaldehyde products and have been constantly improving them during the last eight years we can offer those who use our products the benefit of our long experience.

Bakelite-Dilecto is made in five grades, namely X, X Extra Hard, XX, XXX and Grade G.

The XX Grade Bakelite-Dilecto is the standard material for general mechanical and electrical use combining excellent electrical properties with the strength, uniformity and toughness required for good machining. The XXX Grade is superior electrically but it is more brittle and difficult to machine. Otherwise it is the same as the XX Grade. For both grades the paper is thoroughly saturated with Bakelite by our special process making them more nearly waterproof than other similar materials made of paper which is merely coated.

In the ordinary sense these materials are waterproof but if entirely immersed they will absorb some water. One half inch thick XX Grade Bakelite-Dilecto

Bakelite-Dilecto

will absorb less than 1% of its weight in eight days. The ultimate absorption for all thicknesses is 8% requiring an immersion of three months to two years. They will not however absorb moisture from the atmosphere no matter how humid the climate and they are therefore absolutely non-hygroscopic. Pieces of the XX and XXX Grades when immersed in steam at atmospheric pressure for several days were not affected beyond a slight absorption of moisture. They did not soften, warp, check or split.

The X Grade Bakelite-Dilecto is a material having about the same qualities as the XX Grade but as it is made of paper which is well coated but not quite saturated with Bakelite it is less waterproof. Pieces of this material 1-2" thick will absorb about 6% of their weight of water in eight days and have an ultimate absorption of 18 to 20%. After long periods of immersion in water or a few days in steam, X Grade Bakelite-Dilecto will swell appreciably and split. When used in fairly dry places, however, X Grade Bakelite-Dilecto will be found to be far superior

Bakelite-Dilecto

to hard rubber, Vulcanized Fibre, etc. and practically as good as the XX Grade.

The X Grade Extra Hard Bakelite-Dilecto is the same as regular X Grade except that it is harder and has somewhat better electrical properties. It is more brittle and difficult to machine.

The differences then between the various grades are in their water absorption, hardness and electrical properties. The following remarks apply to all five grades.

Bakelite-Dilecto is remarkable in that it combines in one material the good qualities of many materials with several useful properties which are essentially its own. It replaces Vulcanized Fibre with the added advantage of resisting water, it is about equal to hard rubber electrically without rubber's limitations of temperature and short life, it is stronger and harder than most woods but does not swell or warp, it is the only good insulator having great mechanical strength and at the same time capable of being machined like metals.

Bakelite-Dilecto will withstand a temperature of 220° F (105° C) continuously

Bakelite-Dilecto

and 300° F (150° C) for short periods without softening, blistering, cracking or changing of shape. It is much less inflammable than wood and hard rubber, and burns with difficulty when ignited. It will not melt under any condition. After soaking in gasoline Bakelite-Dilecto is no more inflammable than before and it will not absorb gasoline, kerosene, mineral or vegetable oils.

The linear coefficient of expansion of Bakelite-Dilecto is 0.000014 per degree Fahrenheit (0.000025 per degree Centigrade) up to 140° F (160° C). Above this temperature the expansion is irregular, hence no coefficient can be given. The specific gravity of Bakelite-Dilecto varies from 1.32 to 1.38.

Chemically Bakelite-Dilecto is inert, insoluble and infusible. Strong concentrated acids such as nitric and sulphuric acids carbonize it and strong hot caustic solutions attack it but it is not affected by weak acids or alkalies. The ordinary solvents such as alcohol, benzol, turpentine, acetone, hot water, etc. will not dissolve it. The ozone from high voltage

Bakelite-Dilecto

electrical apparatus quickly ruins hard rubber but it has absolutely no effect on Bakelite-Dilecto.

Working

Bakelite-Dilecto has a smooth hard surface which will take a high polish when sanded and buffed. It may be machined like metals but this work requires special skill and a knowledge of the properties of the material which can be gained only by experience. In the following paragraphs we give a few hints which we hope will prove helpful to those who wish to do their own machine work.

Punching—A plain punch and die may be used on Bakelite-Dilecto sheets or tubes up to 1-8" thick but smooth edges cannot be obtained on a thickness of more than 1-16". The open follow-up or tandem type and compound punch and die may also be used. Dies should be made with the same clearances and proportions as metal cutting dies except that more space should be left between blanks, about six-tenths of the thickness. For good work the punches and dies must be kept

Bakelite-Dilecto

sharp. The strips of Bakelite-Dilecto should be heated thoroughly and uniformly on a steam table or in an electric oven to a temperature of 280° to 300° F (143° to 150° C) and punched quickly before they cool off. A little oil on the strips or grease on the punch is helpful. Holes should not be closer to the edge than the thickness of the piece.

Shaving—Pieces over 1-8" and up to 3-8" thick should be blanked out large and finished in a shaving die. The material should be heated and oiled as in punching.

Shearing—Bakelite-Dilecto should be sheared hot to prevent checking at the edge.

Turning—Bakelite-Dilecto should be turned at a peripheral speed 25% faster than cast iron, using a coarse feed and a wide nosed tool. The tool should have a large clearance but no rake. If possible, the piece should be turned to size in one cut but in any case the finishing cut should remove about 1-8" as it is impossible to take a light cut and have a uniform diameter. The tool is dulled very

Bakelite-Dilecto

quickly so it should be sharpened often. No lubricant is needed.

Drilling—Bakelite-Dilecto should be drilled dry using a fast feed. If the drill is ground properly the hole will be clean and true but about .003" under size, hence to prevent excessive heating the drill should be removed from the hole as quickly as possible. A drill will last about half an hour before re-grinding is necessary. If it is necessary to have the hole the same size or a little larger than the drill, the drill should be ground slightly off centre.

Reaming—Do not ream Bakelite-Dilecto, as it will quickly ruin the reamer. For accurate work holes must be drilled and bored out.

Threading—Ordinary taps and dies make very good threads in Bakelite-Dilecto. A little oil should be used.

Milling—Use a high speed and coarse feed so that the cutter throws chips away from the work. If possible remove all the material in one cut.

Bakelite-Dilecto

Planing—Use high speed and coarse feed as in milling and take a deep cut which should never be less than 1-16".

Sawing—Band and smooth saws such as used for cutting Vulcanized Fibre give equally good results with Bakelite-Dilecto. A smooth saw can be used only ten or fifteen minutes before it is necessary to re-sharpen it. A band saw will last from half an hour to two hours, depending on the thickness and grade of material being cut. Band saws should be re-set every day. We find it necessary to have an automatic saw filing machine for each saw bench.

Bakelite-Dilecto may be knurled, embossed and stamped in the same manner as other materials.

It will be noted from the foregoing that Bakelite-Dilecto is very hard on cutting tools and dulls them very quickly. However, with sharp tools and the proper speed and feed good results can be obtained in any machining operation.

We have a well equipped machine shop as shown in the following illustration and are prepared to furnish parts

Bakelite-Dilecto

made of Bakelite-Dilecto either finished or semi-finished to exact specifications. One of the greatest advantages of Bakelite-Dilecto is that when machined to size it will stay to size and will not change with the weather as is the case with Vulcanized Fibre and other materials. Quotations, together with samples of work done, will be gladly submitted upon receipt of specifications.

BAKELITE-DILECTO SHEETS

Sheets of Bakelite-Dilecto are made by piling up sheets of bakelized paper and heating under very high pressure. The Bakelite first softens making a solid mass of the numerous paper laminations and then hardens. After removal from the press heat will not again soften the sheet. Compared with the method of making Vulcanized Fibre which required many months this process is quick and it is therefore unnecessary to carry large stocks of finished sheets.



Shop for calendering, punching, sawing and machining Vulcanized Fibre and Bakelite-Dilecto

Bakelite-Dilecto

Mechanical Properties

We have had many tests made to determine the strength of Bakelite-Dilecto sheets with the following average results:

	Grades	lb. per sq. in.
Tensile strength:	X, XX and XXX	12,000
Compressive strength:		
Paralled to lamina-	X	20,000
tions,	XX and XXX	22,500
Perpendicular to	X	43,000
laminations,	XX and XXX	41,000
Transverse strength:	X	18,500
	XX and XXX	22,500
Modulus of Elasticity:	X, XX and XXX	1,500,000

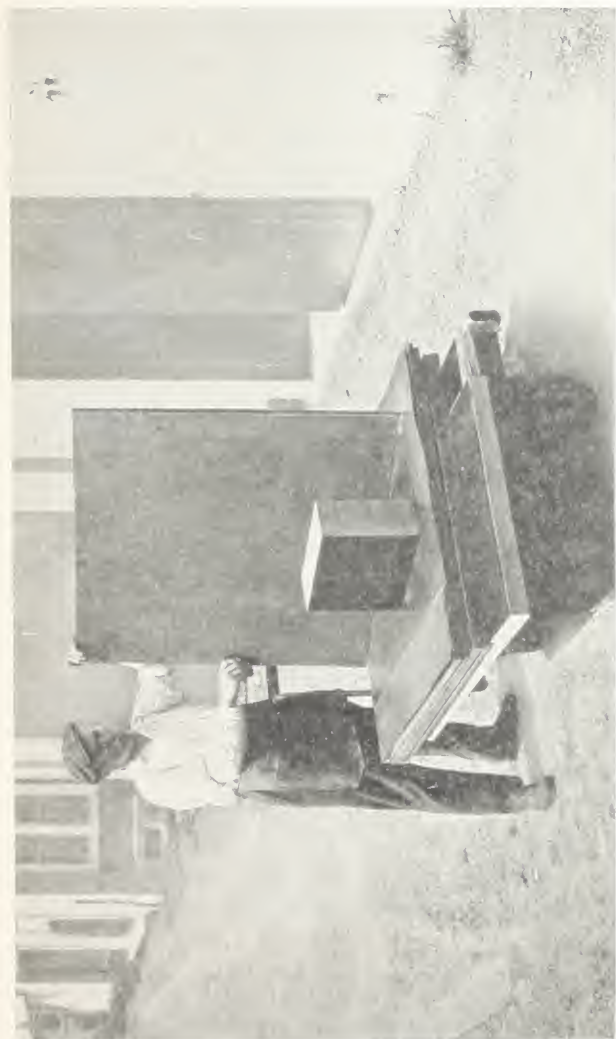
Tension tests were made on specimens having a reduced section 1 1-2" wide, 2" long and the thickness of the sheet. Compression tests were made on square prisms 1-2"x1-2"x1" high, 1"x1"x2" high and 2"x2"x4" high, which are correct proportions for true compression tests. If specimens having an area of one or two square inches and a thickness of only 1-4" are tested the results will be upwards of 60,000 pounds per square inch. This is, however, more of a crushing test than a compression test. The transverse tests

were made on beams 1-2" wide, 1" high and 5" long loaded in the centre, with supports 4" apart. The results show the stress in the outer fibre.

Electrical Properties

The dielectric strength of any insulating material is hard to determine and it varies greatly according to the conditions under which the test is performed. Tests are usually made between two blunt needle point electrodes but on sheets less than 1-8" thick such electrodes gives values which are too high, due principally to the small area which is subjected to the high voltage and the rapid radiation of heat. We have, therefore, adopted the practice of using disc electrodes 1" in diameter for sheets 1-8" and less in thickness and blunt needle points for thicker sheets.

The tests were made under oil with 60 cycle alternating voltage increasing from zero to the puncture point at the rate of approximately 5,000 volts per second and gave the following average results:



Bakelite-Dilecto and Continental-Bakelite Sheets

Bakelite-Dilecto

Thickness, inches, all grades	Volts per mil	Volts per mm.
1/32	1,000	39,400
1/16	850	33,500
1/8	650	25,800
1/4	500	19,800
1/2	450	17,700

When using this data as a basis for the design of electrical apparatus it should be remembered that the figures given are breakdown values with voltage applied for only a few seconds. A reasonable factor of safety should be used depending on the nature of the apparatus and the conditions under which it is to be used. We believe in no case should the factor of safety be less than six.

The insulation resistance varies greatly with different sheets and with the humidity of the air. For XX Grade Bakelite-Dilecto the volume resistivity is about 1,000,000 megohms (10^{11} ohms) per centimeter cube and the surface resistivity across a square varies from 100 megohms (10^8 ohms) to 10,000,000 megohms (10^{12} ohms).

The dielectric constant of XX Grade Bakelite-Dilecto is approximately five and

Bakelite-Dilecto

the angle of phase difference approximately two degrees at high frequencies.

Sizes

Standard sheets measure approximately 38"x38" or 30"x40", and can also be supplied approximately 38"x45" in any thickness from .005" to 4". The dimensions are reasonably accurate, variations in thickness being no greater than given in the following table:

1/64" thick or under, plus or minus	.005"
Over 1/64" to 1/32" inc. plus or minus	.005"
Over 1/32" to 1/16" inc. plus or minus	.007"
Over 1/16" to 1/8" inc. plus or minus	.010"
Over 1/8" to 3/16" inc. plus or minus	.012"
Over 3/16" to 5/16" inc. plus or minus	.015"
Over 5/16" to 3/8" inc. plus or minus	.020"
Over 3/8" to 1/2" inc. plus or minus	.025"
Over 1/2" to 1" inc. plus or minus	.030"
Over 1" to 1½" inc. plus or minus	.040"
Over 1½" thick inc. plus or minus	.060"

We can make sheets to closer variation in special cases.

Colors

Bakelite-Dilecto is furnished in two standard colors, natural and black. The natural color varies from light to dark brown and the black closely resembles

Bakelite-Dilecto

hard rubber in appearance. XX and XXX Grade sheets can be furnished in either color but X Grade and X Grade Extra Hard in natural color only. We can, however, at a small increase in price put a black surface on natural X Grade sheets.

Uses

There are innumerable uses for Bakelite-Dilecto in sheet form. It is the best material known for panels, frames, bases and other parts of wireless telegraph and other high voltage apparatus. Punchings of all shapes and sizes are used in the manufacture of telephone apparatus where its property of retaining a high insulation resistance in damp places is very important. Its strength and insulating properties make it especially useful for spool heads of electro magnets and generator pole pieces and for end rings on direct current motors. Washers and discs punched from Bakelite-Dilecto sheets have a wide application.

Aside from its use as an insulating material the great strength and good ma-

Bakelite-Dilecto

chining qualities of Bakelite-Dilecto make it applicable to a large number of mechanical uses where for any reason metals are not desired. One of these reasons is weight. Bakelite-Dilecto weighs only half as much as cast aluminum and has 90% of its tensile strength.

Approximate Weight of Standard Bakelite-Dilecto Sheets

Thickness inches	Weight pounds		Thickness inches	Weight pounds	
	30" x 40"	38 x 38"		30" x 40"	38" x 38"
1/64	1	1	13/16	48	57
1/32	2	2 1/4	7/8	51	62
3/64	2 3/4	3 1/4	15/16	55	66
1/16	3 3/4	4 1/2	1	59	70
3/32	5 1/2	6 1/2	1 1/8	66	79
1/8	7 1/4	8 3/4	1 1/4	73	88
3/16	11	13	1 3/8	80	97
1/4	15	18	1 1/2	88	105
5/16	18	22	3/4	102	123
3/8	22	26	2	117	141
7/16	26	31	2 1/4	132	158
1/2	29	35	2 1/2	146	176
9/16	33	40	3	161	193
5/8	37	44	3 1/4	175	211
11/16	40	48	3 1/2	204	246
3/4	44	53	4	234	282

To obtain the approximate weight of any Bakelite-Dilecto piece allow one pound for each 20.5 cubic inches.

Bakelite-Dilecto

It is unnecessary to go into detail with regard to the uses to which this material may be put, suffice it to say that wherever a strong, waterproof, insulating sheet is needed Bakelite-Dilecto should be specified.

Grade G Bakelite-Dilecto is practically the same kind of material as Grade XX, excepting it is especially made for the purpose of manufacturing Noiseless Gears. For this use it is an ideal material. Gears made from Grade G Bakelite-Dilecto may be run in oil, and are not injured by water or acid fumes. When properly designed and applied, a Grade G Bakelite-Dilecto Gear will outlast any other non-metallic Gear and will have almost the same life as cast iron or brass.

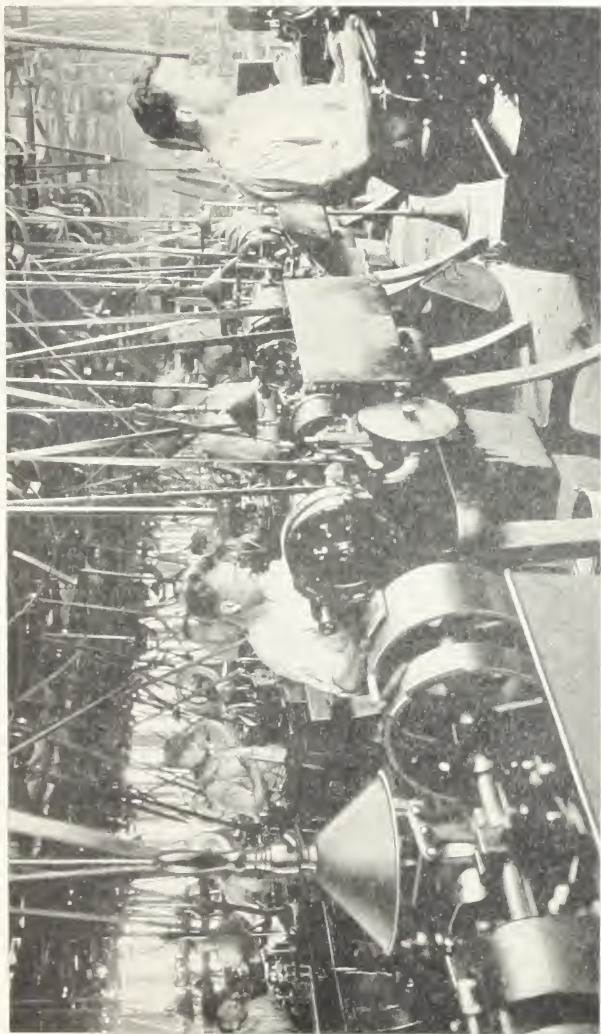
The teeth cut in Grade G Bakelite-Dilecto are self supporting, and, therefore, need no shroud. Gears of large diameter, in proportion to face, sometimes need end plates to reinforce the hub. They are vermin proof and do not deteriorate with age. The elasticity of Grade G Bakelite-Dilecto enables the teeth to make even contact across their full width.

Bakelite-Dilecto

Grade G Bakelite-Dilecto Gears are made by cutting blanks from sheet stock and finishing in a gear shaper, miller or hobber. For Gears over 3" face, two or more blanks are riveted or bolted together. We can supply Bakelite-Dilecto Grade G Gear stock in Sheets or band sawed Blanks only to Licensed Gear Manufacturers. We do not make finished Gears.

When using Grade G Bakelite-Dilecto for Gears, the pitch should be coarse enough to avoid overstressing the material on overloads or impact. When so designed they give long service.

Machining qualities of Grade G Bakelite-Dilecto are about the same as XX Grade, and the information given with regard to that material should be followed in machining Grade G. It should be noted that there is no advantage to be found in the use of lubricants in machining this material. At times a lubricant is the cause of trouble. When it is practical to do so, Discs may be cut from Sheet material with accuracy with a Trepine Tool, as well as band sawed. In milling Grade G material a slow cutting feed, ten inches



Automatic Screw Machines for Vulcanized Fibre and Bakelite-Dilecto

Bakelite-Dilecto

per minute, and relatively high speeds, sixty-five feet per minute are suggested.

BAKELITE-DILECTO TUBES

Bakelite-Dilecto tubes are made by wrapping Bakelized paper on a mandrel and hot pressing in a mould. The chemical and mechanical actions are the same as in making sheets. Tubes over 6" outside diameter and odd sizes for which we have no moulds are made by heating under air pressure and are called rolled tubes. They are inferior to moulded tubes, however, and we do not recommend them for high voltage work nor heavy mechanical stress.

Mechanical Properties

We have had many tests made to determine the strength of Bakelite-Dilecto tubes with the following average results:

	Grades	lb. per sq. in.
Tensile strength:	X and XX	8,000
	XXX	6,500
Compressive strength:	X	18,000
	XX and XXX	21,000

Bakelite-Dilecto

The compression tests were made on pieces of tubing of 1" outside diameter and 2" high with several wall thicknesses.

Electrical Properties

The dielectric strength of insulating tubes varies with conditions and manner of testing to a greater extent than sheet material. Blunt needle points give results which are unreliable and generally too high so we have used electrodes consisting of a snug fitting mandrel inside the tubes and a strip of brass outside. This method tests the entire circumference and picks out the weak spot.

The tests were made under oil with 60 cycle alternating voltage increasing from zero to the puncture point at the rate of approximately 5,000 volts per second and gave the following average results:

Wall thickness, inches, all grades	Volts per mil	Volts per mm.
1/32	350	13,800
1/16	450	17,700
1/8	500	19,700
1/4	350	13,800
1/2	300	11,800

When using these data as a basis for the design of electrical apparatus a factor of safety of at least six should be used.

Sizes

The minimum inside diameter of moulded tubes is 3-32" and the maximum outside diameter is 6" with wall thicknesses of 1-64" and over. Tubes from 3-32" to 7-32" inside diameter are made 18" long and all other sizes are made approximately 37" long. Rolled tubes may be had with inside diameters from 1 1-2" up with any wall thickness.

Tubes are never undersize but may be .005" oversize on the inside diameter and .020" on the outside diameter. The outside of tubes, especially those with thick walls are not exactly round and may be slightly eccentric with the hole. For accurate fitting they must be turned to size.

Most tubes have a circular section but we can make square tubes and round tubes with square holes or square tubes with round holes. In fact any form of tube with uniform cross section can be made provided the number required is

Bakelite-Dilecto

large enough to cover the cost of special equipment. The illustration on opposite page show some of the tubes we have made.

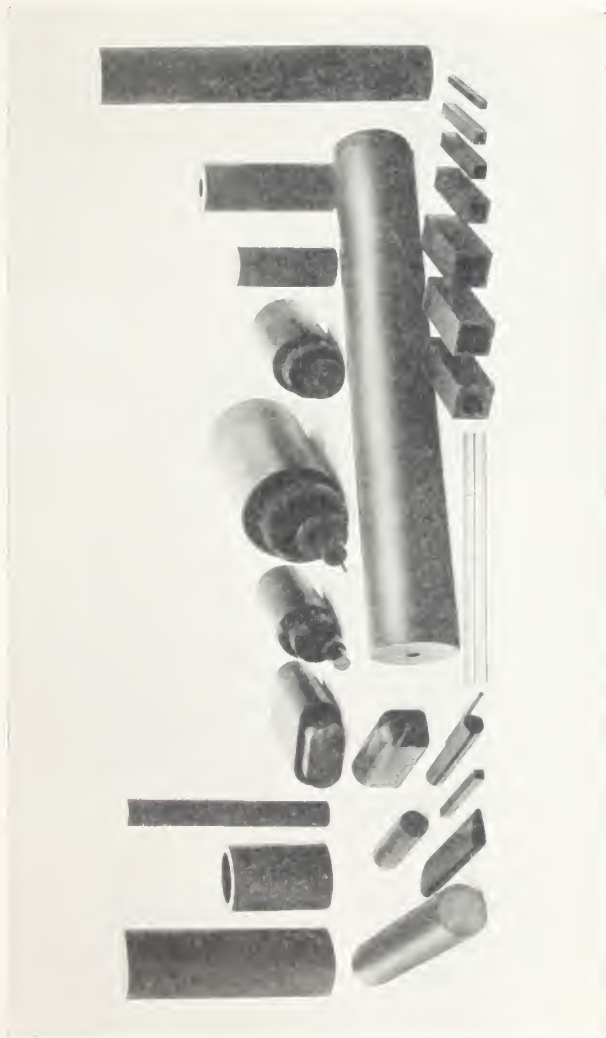
Colors

Grades XX and XXX tubes are made black or natural but X Grade tubes and rolled tubes are natural color only.

Uses

Bakelite-Dilecto tubes make the best cores for turning coils, variometers and other wireless telegraph apparatus. Smaller tubes are used for handles and shafts on high tension switches. They make excellent bushings for the high voltage leads and connection wires.

As cores for electro-magnet windings and covers for spark coils they have no equal. Bakelite-Dilecto tubes may be used to advantage on all kinds of electrical machinery such as brush holder bushings (round or square) bolt and shaft insulation, etc. on motors and generators and in drum controllers. A large variety of insulating bushings may be made from standard tubes.



A few forms and sizes of Bakelite-Dilecto tubes and rods

Bakelite-Dilecto

Lengths of tubes threaded on the ends and short lengths made into couplings may be connected together as piping for corrosive liquids and liquids which would be spoiled by contact with metal pipes. Piping made in this way has been found useful in chemical plants and especially in the manufacture of vinegar. Many parts of cider and vinegar making apparatus which cannot be made of metal and which give trouble when made of wood prove entirely satisfactory when made of Bakelite-Dilecto.

Bakelite-Dilecto tubes make very good conduits for the high tension cables on automobile, motorboat and airplane engines. They are excellent insulators, easy to make, strong and not damaged by heat and oil from the engine.

Correspondence is solicited on any proposed uses for our tubes and we will gladly furnish quotations and samples.

BAKELITE-DILECTO RODS

We make two kinds of Bakelite-Dilecto Rods, turned and moulded. The turned rods are cut from sheet material

Bakelite-Dilecto

in special rod machines. Moulded rods are pressed in moulds. The price is the same for both and we leave the choice to the user as to which kind best suits his conditions. The laminations of turned rods are parallel chords of the circular section whereas the laminations of moulded rods are concentric circles.

Mechanical Properties

Since turned rods are cut from sheets their mechanical strength will be the same as given under the properties of sheet material. Tests of moulded rods show the following average results:

	Grades	lb. per sq. in.
Tensile strength:	XX and XXX	9,000
Compressive strength:	XX and XXX	25,000

The tension specimens were pieces of 1" moulded rod with a reduced section of 1-2" diameter, 2" long. The compression test specimens were 1-2", 1" and 2" in diameter and 1", 2" and 4" long respectively.

Sizes

Moulded rods may be obtained in XX or XXX Grades about 18" long with diameters from 1-4" to 5-16" inclusive and approximately 37" long with diameters from 21-64" to 3" inclusive. Turned rods are made up to 37" long with any diameter from 1-8" to 4" inclusive in any grade.

Rods with special sections will be furnished on orders large enough to cover the cost of the special equipment.

Colors

Turned rods are natural or black for XX and XXX grades. Moulded rods are natural or black.

Uses

Bakelite-Dilecto Rods make excellent posts, shafts, handles, levers and connecting rods for high voltage apparatus where a strong insulating material of the highest quality is required. There are several insulating rods required on every wireless telegraph and telephone set and for this work our rods have no equal.

Bakelite-Dilecto

Many machined parts can be made from rods and if desired we can supply such parts finished to size.

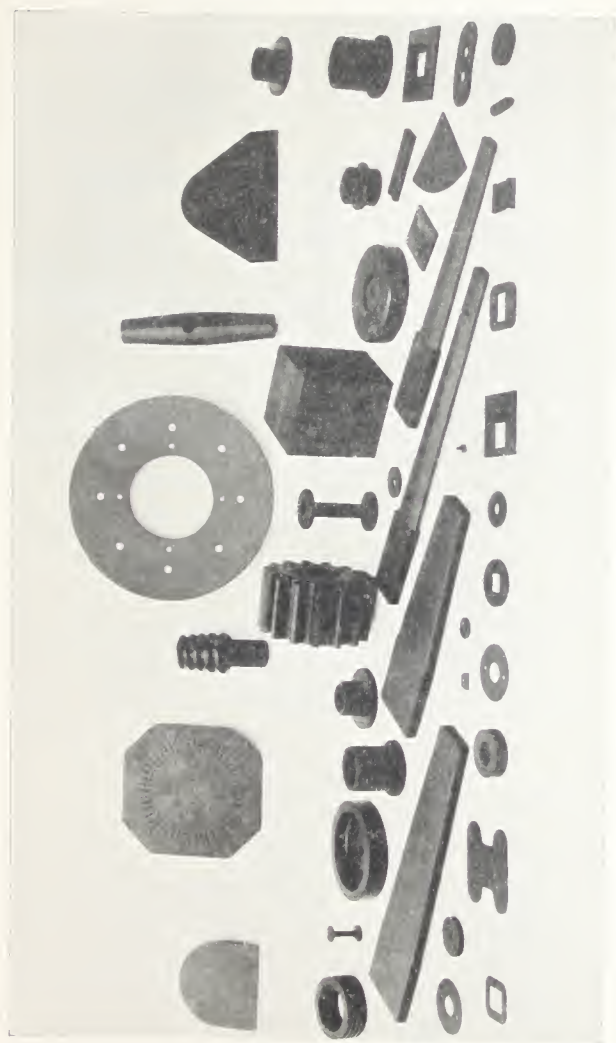
SPECIAL PRODUCTS

Bakelite-Dilecto—Grade A

The regular grades of Bakelite-Dilecto will burn and be entirely consumed in a flame or if close to other burning material. We have, therefore, developed a less inflammable material known as Bakelite-Dilecto Grade A which is made of asbestos paper and Bakelite. It will withstand higher temperature and is more difficult to ignite than the XX grade, in fact, it will not burn unless put in a fire, in which case the Bakelite burns away leaving the paper in its original form and possessing enough strength to hold its shape.

The main advantages obtained by the use of Grade A are that it contains much less combustible matter and that it will stay in place while burning and will not ignite other apparatus or buildings by falling away.

Grade A Bakelite-Dilecto can be sup-



A few parts made of Bakelite-Dilecto

Bakelite-Dilecto

plied in sheet, tube or rod form in the same sizes as the XX grade.

Bakelite-Dilecto—Grade S

We have developed a method of applying a hard rubber surface to XX grade Bakelite-Dilecto to meet the demand for a material having the surface characteristics of hard rubber combined with the high mechanical and dielectric strength of Bakelite-Dilecto. This material is known as Bakelite-Dilecto Grade S and can be supplied in the form of sheets, tubes or rods.

Sheets may have the rubber surface on one or both sides. They measure approximately 12"x12", 30"x40" and 38"x38" and may be obtained in any thickness from 3-16" to 5-8".

Tubes are surfaced with rubber on the outside only. They are made with a minimum inside diameter of 3-32" and maximum outside diameter of 6" with any wall thickness from 3-16" to 5-8". When the inside diameter is less than 1-4" the length is about 18"; other sizes are approximately 18", 30" or 36" long.

Bakelite-Dilecto

Rods are about 18", 30" or 36" long with any diameter from 5-8" to 1 1-2".

In all cases the dimensions given include the rubber which may be either 1-32" or 1-16" thick.

We are ready at all times to investigate new problems involving the use of Bakelite with fibrous sheet materials. When our regular products do not answer the purpose we endeavor to develop special materials or it may be possible to incorporate other materials in our regular products. We have recently made some XX Grade Bakelite-Dilecto with several layers of brass wire cloth imbedded between the paper laminations.

Correspondence on new or unusual applications is cordially solicited.

CONTINENTAL-BAKELITE



CONTINENTAL-BAKELITE

CONTINENTAL-BAKELITE is a very tough, strong insulating material made by hot pressing canvas or cloth which has been saturated with raw Bakelite. By this process we have produced a material which has most of the well known properties of Bakelite and at the same time possesses great mechanical and dielectric strength.

Our Bakelite products and methods of manufacture are fully protected by patents, granted or pending, which are owned by us or by others to whom we are licensed.

Continental-Bakelite is manufactured in the form of sheets, tubes and rods. The sheets are not necessarily made flat, nor the tubes and rods of circular section, for any cylindrical shape with uniform wall thickness may be made in special moulds. When once made, however, its

Continental-Bakelite

form cannot be altered except by machining.

As we are the original manufacturers of laminated phenol formaldehyde products and have been constantly improving them during the last eight years, we can offer those who use our products the benefit of our long experience.

Continental-Bakelite is made in two grades, namely, CB and CBL, the chief difference being that grade CB is made of cotton duck and grade CBL of thin cotton cloth. The general properties of both grades are identical but they differ somewhat in mechanical and dielectric strength. As each ply of the CB grade is .020" thick it follows that it is impossible to obtain close limits of thickness. Each ply of the CBL grade is only .005" thick so this grade should be specified for sheets and tubes less than 3-32" thick and for rods and tubes of less than 5-8" diameter.

Only the best grades of canvas and cloth are used and they are thoroughly saturated with Bakelite before pressing.

In the ordinary sense, Continental-Bakelite is waterproof in that water does not injure it even when immersed for long

Continental-Bakelite

periods. Pieces of Continental-Bakelite 1-4" thick will absorb about 2% of their weight of water in eight days. It will not absorb moisture from the atmosphere even in a humid climate and it is therefore absolutely non-hygroscopic. Continental-Bakelite will absorb a small amount of machine oil but the oil does not soften or weaken it or cause it to swell. Soaking in gasoline or kerosene does not injure it and after soaking it is non-inflammable. Steam at atmospheric pressure has no effect beyond a slight absorption of moisture and very slight softening.

Continental-Bakelite will withstand a temperature of 220° F (105° C) continuously and 300° F (150° C) for short periods without softening, blistering, cracking or changing of shape. It is much less inflammable than wood and hard rubber and burns with difficulty when ignited. It will not melt under any condition.

The linear coefficient of expansion of Continental-Bakelite is 0.000017 per degree Fahrenheit (0.00003) per degree Centigrade up to 140° F (60° C). Above this temperature the expansion is irregu-

Continental-Bakelite

lar, hence no coefficient can be given. The specific gravity of Continental-Bakelite is 1.36.

Chemically, Continental-Bakelite is inert, insoluble and infusible. Strong concentrated acids such as nitric and sulphuric, carbonize it and strong hot caustic solutions attack it, but it is not affected by weak acids or alkalies. The ordinary solvents such as alcohol, benzol, turpentine, acetone, hot water, etc, will not dissolve it.

Working

The surface of Continental-Bakelite is a very thin, transparent layer of Bakelite showing the texture of the fabric underneath. It is smooth but will not take a high polish like Bakelite-Dilecto. To obtain a good finish on machined surfaces, smooth with emery cloth and rub with oil. Continental-Bakelite may be machined like metals, but this work requires special skill and knowledge of the properties of the material which can be gained only by experience. In the following paragraphs we give a few hints which we hope will



Some parts made of Continental-Bakelite sheets, tubes and rods

Continental-Bakelite

prove helpful to those who wish to do their own machine work.

Punching—A plain punch and die may be used on Continental-Bakelite sheets or tubes up to 1-8" thick. The open follow-up or tandem type or compound punch and die may also be used on sheets 1-16" thick or less. Dies should be made with the same clearances and proportions as metal cutting dies except that more space should be left between blanks (about .6 of the thickness). For good work, the punches and dies must be kept sharp. The strips of Continental-Bakelite should be heated thoroughly and uniformly on a steam table or in an electric oven to a temperature of 280° to 300° F (140° to 150° C) and punched quickly before they cool off. A little oil on the strips or grease on the punch is helpful. Holes should not be closer to the edge than the thickness of the piece.

Shaving—Pieces over 1-8" and up to 3-8" thick should be blanked out large and finished in a shaving die. The material should be heated and oiled as in punching.

Shearing---Continental-Bakelite should

Continental-Bakelite

be sheared hot to prevent checking at the edges.

Turning—Continental-Bakelite should be turned at a peripheral speed 25% faster than cast iron using a coarse feed and a wide nosed tool. The tool should have a large clearance but no rake. If possible, the piece should be turned to size in one cut but in any case the finishing cut should remove about 1-8" as it is impossible to take a light cut and have a uniform diameter. The tool is dulled very quickly so it should be sharpened often. No lubricant is needed.

Drilling—Continental-Bakelite should be drilled dry using a fast feed. If the drill is ground properly the hole will be clean and true but about .003" under size, hence, to prevent excessive heating the drill should be removed from the hole as quickly as possible. A drill will last about two hours before re-grinding is necessary. If it is necessary to have the hole the same size or a little larger than the drill, the drill should be ground slightly off centre.

Continental-Bakelite

Reaming—Do not ream Continental-Bakelite as it will quickly ruin the reamer. For accurate work, holes must be drilled and bored out.

Threading—Ordinary taps and dies are used with a little oil. It is practically impossible to obtain clean sharp threads on Continental-Bakelite for, being made of fabric, the cut edges are slightly fuzzy. Threads can be made, however, if the tools are sharp and while they do not look very good, they will be strong enough not to strip in ordinary use.

Milling—Use a high speed and coarse feed so that the cutter throws chips away from the work. If possible remove all the material in one cut.

Planing—Use high speed and coarse feed as in milling and take a deep cut which should never be less than 1-16".

Sawing—Band and smooth saws such as used for cutting Vulcanized Fibre give equally good results with Continental-Bakelite. A smooth saw can be used from thirty minutes to one hour before it is necessary to re-sharpen it. A band

Continental-Bakelite

saw will last from two hours to half a day depending on the thickness of the material being cut. Band saws should be re-set every day. We find it necessary in our shop to have a saw filing machine for each saw bench.

Continental-Bakelite may be knurled, embossed and stamped in the same manner as other materials.

It will be noted from the foregoing paragraphs that Continental-Bakelite is hard on cutting tools and dulls them quickly but it is better in this respect and may be worked more readily than Bakelite-Dilecto.

We have a well equipped machine shop and are prepared to furnish parts made of Continental-Bakelite either finished or semi-finished. Quotations, together with samples of work done will be gladly submitted on receipt of specifications.

CONTINENTAL-BAKELITE SHEETS

Continental-Bakelite sheets are made by piling up sheets of Bakelized canvas or cloth and heating under very high pres-

Continental-Bakelite

sure. The Bakelite first softens making a solid mass of the numerous laminations and then hardens. After removal from the press, heat will not again soften the sheet. Compared with the method of making Vulcanized Fibre which requires many months, this process is quick and it is, therefore, unnecessary to carry large stocks of finished sheets.

Mechanical Properties

We have had many tests made to determine the strength of Continental-Bakelite sheets with the following average results:

	Grades	lb. per sq. in.
Tensile strength:	CB and CBL	8,500
Compressive strength:		
Parallel to lamina-	CB	20,000
tions,	CBL	23,000
Perpendicular to lam-	CB	35,000
inations,	CBL	41,000
Transverse strength:	CB	17,000
	CBL	19,000
Modulus of Elasticity:	CB	350,000
	CBL	850,000

Tension Tests were made on specimens having a reduced section 1 1-2"

Continental-Bakelite

wide, 2" long and the same thickness as the sheet. Compression tests were made on square prisms 1-2"x1-2"x1" high, 1"x1"x2" high and 2"x2"x4" high, which are correct proportions for true compression tests. If specimens having an area of one or two square inches and only 1-4" thick are tested, the results will be upwards of 60,000 pounds per square inch. This is, however, more of a crushing test than a compression test. The transverse tests were made on beams 1-2" wide, 1" high and 5" long, loaded in the centre, with supports 4" apart. The results show the stress in the outer fibre.

Electrical Properties

The dielectric strength of any insulating material is hard to determine and it varies greatly according to the conditions under which the test is performed. Tests are usually made between two blunt needle point electrodes but on sheets less than 1-8" thick, such electrodes give values which are too high, due principally to the small area which is subjected to the high voltage and the rapid radiation of

Continental-Bakelite

heat. We have, therefore, adopted the practice of using disc electrodes 1" in diameter for sheets 1-8" and less in thickness and blunt needle points for thicker sheets.

The tests were made under oil with 60 cycle alternating voltage increasing from zero to the puncture point at the rate of approximately 5,000 volts per second and gave the following average results:

Thickness, inches	Volts per mil	Volts per mm.
1/32	550	21,600
1/16	500	19,700
1/8	400	15,700
1/4	300	11,800
1/2	200	7,900

When using these data as a basis for the design of electrical apparatus, it should be remembered that the figures given are breakdown values with voltage applied for only a few seconds. A reasonable factor of safety should be used depending on the nature of the apparatus and the conditions under which it is to be used. We believe that in no case should the factor of safety be less than six.

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Sizes

Continental-Bakelite sheets are made approximately 28"x40" and 38"x38" with any thickness from one ply to 4". Longer sheets can be obtained at an increased price. The dimensions are reasonably accurate, variations in thickness being no greater than given in the following table:

1/64" thick or under, plus or minus	.003"
Over 1/64" to 1/32" inc. plus or minus	.005"
Over 1/32" to 1/16" inc. plus or minus	.007"
Over 1/16" to 1/8" inc. plus or minus	.010"
Over 1/8" to 3/16" inc. plus or minus	.012"
Over 3/16" to 5/16" inc. plus or minus	.015"
Over 5/16" to 3/8" inc. plus or minus	.020"
Over 3/8" to 1/2" inc. plus or minus	.025"
Over 1/2" to 1" inc. plus or minus	.030"
Over 1" to 1 1/2" inc. plus or minus	.040"
Over 1 1/2" thick inc. plus or minus	.060"

In special cases we can supply sheets having closer limits of thickness.

Colors

Both the CB and CBL grades of Continental-Bakelite are furnished in two colors, natural (reddish brown) and black.

CONTINENTAL-BAKELITE TUBES

Continental-Bakelite tubes are made by wrapping Bakelized Canvas or cloth on a mandrel and hot pressing in a mould. The chemical and mechanical actions are the same as in making sheets.

Mechanical Properties

We have had many tests made to determine the strength of Continental-Bakelite tubes with the following average results:

	Grades	lb. per sq. in.
Tensile strength:	CB	7,000
	CBL	9,000
Compressive strength:	CB and CBL	20,000

The compression tests were made on pieces of tubing of 1" outside diameter and 2" high with several wall thicknesses.

Electrical Properties

The dielectric strength of insulating tubes varies with conditions and manner of testing to a greater extent than sheet material. Blunt needle points give results

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which are unreliable and generally too high so we have used electrodes consisting of a snug fitting mandrel inside the tubes and a strap of brass outside. This method tests the entire circumference and picks out the weak spot.

The tests were made under oil with 60 cycle alternating voltage increasing from zero to the puncture point at the rate of approximately 5,000 volts per second and gave the following average results:

Wall thickness, inches	Volts per mil	Volts per mm.
1/16	250	9,900
1/8	350	13,800
1/4	250	9,900

When using these data as a basis for the design of electrical apparatus a factor of safety of at least six should be used.

Sizes

The minimum inside diameter of Continental-Bakelite tubes is 3-32" and the maximum outside diameter is 6" with wall thicknesses of 1-64" and over. Tubes from 3-32" to 7-32" inside diameter are made about 18" long and all other sizes

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are made about 36" long. Grade CBL will be furnished when the diameter is less than 5-8" or the wall thickness less than 3-32".

Tubes are never under size but may be .005" over size on the inside diameter and .020" on the outside diameter. The outside of tubes, especially those with thick walls are not exactly round and may be slightly eccentric with the hole. For accurate fitting they must be turned to size.

Most tubes have a circular section but we can make several sizes of square tubes and round tubes with square holes or square tubes with round holes. In fact any form of tube with uniform cross section can be made provided the number required is large enough to cover the cost of special equipment.

Colors

Natural and black are the standard colors for Continental-Bakelite tubes.

CONTINENTAL-BAKELITE RODS

We make two kinds of Continental-Bakelite Rods, turned and moulded. The turned rods are cut from sheet material in special rod machines. Moulded rods are pressed in moulds. The price is the same for both and we leave the choice to the user as to which kind best suits his conditions. The laminations of the turned rods are chords of the circular section, whereas the laminations of moulded rods are concentric circles.

Mechanical Properties

Since turned rods are cut from sheets their mechanical strength will be the same as given under the properties of sheet material. Tests of moulded rods show the following average results:

	Grades	lb. per sq. in.
Tensile strength:	CB and CBL	8,000
Compressive strength:	CB and CBL	25,000

The tension specimens were pieces of 1" moulded rod with a reduced section of 1-2" diameter, 2" long. The compression

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test specimens were 1-2", 1" and 1 1-2" in diameter and 1", 2" and 3" high respectively.

Sizes

Rods of Continental-Bakelite are made about 18" long with diameters from 1-4" to 5-16" inclusive and approximately 36" long with diameters from 21-64" to 3" inclusive. Turned rods may be obtained having any diameter from 1-8" to 4" in random lengths up to 36".

Rods made in moulds are subject to the same variations as the outside diameters of tubes. Rods with special sections will be furnished on orders large enough to cover the cost of the special equipment.

Colors

Both moulded and turned rods may be obtained in two colors, natural and black.

FIELDS OF USEFULNESS

Continental-Bakelite was developed to provide a better insulation than Vulcanized Fibre for railway track signal circuits. That its use is rapidly increasing is due solely to its superior qualities and greater economy for it will outwear from nine to seventeen sets of ordinary fibre insulation. A dry fibre end post has a crushing strength of about 40,000 pounds per square inch but its strength decreases to 10,000 pounds per square inch after it has soaked in water for a few days. An end post of Continental-Bakelite on the other hand has an initial strength of over 40,000 pounds per square inch and this strength does not decrease no matter how long it is under water. It will also retain a much higher electrical insulating value than is needed for the proper operation of signals. We can supply Continental-Bakelite parts to fit any insulated joint.

Continental-Bakelite is an excellent material for brake bands or shoes as it does not dry up in hot weather nor swell in wet weather and is not injured by water, oil or tar. The same qualities make it

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especially useful for dust guards. In fact Continental-Bakelite may be used advantageously for any purpose requiring a tough, strong material which will stand hard use and exposure to the weather.

Tubes made of Continental-Bakelite make very good conduits for high tension cables on automobile, motor boat and airplane engines. They are good insulators, easy to make, strong and not damaged by heat and oil from the engine.

Continental-Bakelite is not so good an insulator as Bakelite-Dilecto, hard rubber, etc., but it is far superior to Vulcanized Fibre and shellac compositions. We recommend it for cases where toughness and wearing qualities are essential and where insulation is of secondary importance.

Continental-Bakelite is not sold for the purpose of manufacturing noiseless gears. Our special Grade G Bakelite-Dilecto is supplied for that purpose.

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Approximate Weight of Standard Continental-Bakelite Sheets

Thickness inches	Weight pounds		Thickness inches	Weight pounds	
	28"x40"	38"x38"		28"x40"	38"x38"
1/64	3/4	1	13/16	44	57
1/32	1 3/4	2 1/4	7/8	48	62
3/64	2 1/2	3 1/4	15/16	51	66
1/16	3 1/2	4 1/2	1	55	70
3/32	5	6 1/2	1 1/8	62	79
1/8	6 3/4	8 3/4	1 1/4	68	88
3/16	10	13	1 3/8	75	97
1/4	14	18	1 1/2	82	105
5/16	17	22	3/4	96	123
3/8	20	26	2	109	141
7/16	24	31	2 1/4	123	158
1/2	27	35	2 1/2	136	176
9/16	31	40	3	150	193
5/8	34	44	3 1/2	164	211
11/16	38	48	4	191	246
3/4	41	53		218	282

To obtain the approximate weight of any Continental-Bakelite piece allow one pound for each 20.5 cubic inches.

Decimal Equivalents

Decimal Equivalents

	In-ches	In-ches	Milli-meters	In-ches	In-ches	Milli-meters
		.0079	.2	9/32	.2813	7.15
1/64		.0156	.4	5/16	.3125	7.95
		.0236	.6		.3150	8.
1/32		.0314	.8	11/32	.3438	8.74
		.0394	1.		.3543	9.
3/64		.0469	1.19	3/8	.3750	9.54
		.0590	1.5		.3937	10.
1/16		.0625	1.59	13/32	.4063	10.33
5/64		.0781	1.99		.4331	11.
		.0787	2.	7/16	.4375	11.12
3/32		.0938	2.38	15/32	.4688	11.92
		.0984	2.5		.4724	12.
7/64		.1094	2.78	1/2	.5000	12.71
		.1181	3.		.5118	13.
1/8		.1250	3.18		.5512	14.
		.1378	3.5	9/16	.5625	14.30
9/64		.1406	3.58		.5906	15.
5/32		.1563	3.97	5/8	.6250	15.89
		.1575	4.		.6299	16.
11/64		.1719	4.37	11/16	.6875	17.48
		.1772	4.5		.7087	18.
3/16		.1875	4.77	3/4	.7500	19.07
		.1969	5.		.7874	20.
13/64		.2031	5.16	13/16	.8125	20.65
		.2165	5.5		.8681	22.
7/32		.2188	5.56	7/8	.8750	22.24
15/64		.2344	5.96	15/16	.9375	23.83
		.2362	6.		.9449	24.
1/4		.2500	6.36	63/64	.9843	25.
		.2756	7.	1	1.0000	25.42

Decimal Equivalents

Decimal Equivalents

In-ches	In-ches	Milli-meters	In-ches	In-ches	Milli-meters
$1\frac{1}{8}$	1.125	28.60	$3\frac{1}{8}$	3.125	79.44
	1.181	30.		3.150	80.
$1\frac{1}{4}$	1.250	31.78	$3\frac{1}{4}$	3.250	82.62
$1\frac{3}{8}$	1.375	34.96		3.347	85.
	1.378	35.	$3\frac{3}{8}$	3.375	85.80
$1\frac{1}{2}$	1.500	38.13	$3\frac{1}{2}$	3.500	88.98
	1.575	40.		3.543	90.
$1\frac{5}{8}$	1.625	41.31	$3\frac{5}{8}$	3.625	92.15
$1\frac{3}{4}$	1.750	44.49		3.740	95.
	1.772	45.	$3\frac{3}{4}$	3.750	95.33
$1\frac{7}{8}$	1.875	47.66	$3\frac{7}{8}$	3.875	98.51
	1.969	50.		3.937	100.
2	2.000	50.84	4	4.000	101.69
$2\frac{1}{8}$	2.125	54.02	$4\frac{1}{4}$	4.250	108.04
	2.165	55.		4.331	110.
$2\frac{1}{4}$	2.250	57.20	$4\frac{1}{2}$	4.500	114.40
	2.362	60.		4.724	120.
$2\frac{3}{8}$	2.375	60.38	$4\frac{3}{4}$	4.750	120.75
$2\frac{1}{2}$	2.500	63.55	5	5.000	127.11
	2.559	65.		5.118	130.
$2\frac{5}{8}$	2.625	66.73	$5\frac{1}{4}$	5.250	133.46
$2\frac{3}{4}$	2.750	69.91	$5\frac{1}{2}$	5.500	139.82
	2.756	70.		5.512	140.
$2\frac{7}{8}$	2.875	73.08	$5\frac{3}{4}$	5.750	146.17
	2.953	75.		5.906	150.
3	3.000	76.26	6	6.000	152.53



